

# TVS Diodes

Transient Voltage Suppressor Diodes

## ESD103-B1-02 Series

Bi-directional Femto Farad Capacitance TVS Diode

ESD103-B1-02ELS  
ESD103-B1-02EL

## Data Sheet

Revision 1.3, 2014-06-12  
Final

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# 1 Bi-directional Femto Farad Capacitance TVS Diode

## 1.1 Features

- ESD/Transient protection of RF and ultra-high speed signal lines according to:
  - IEC61000-4-2:  $\pm 10$  kV (contact)
- Extremely low capacitance  $C_L = 0.09$  pF (typical) at  $f = 1$  GHz
- Maximum working voltage:  $V_{RWM} = \pm 15$  V
- Very low reverse current:  $I_R < 0.1$  nA (typ.)
- Very low series inductance down to 0.2 nH typical (TSSLP-2-4)
- Extremely small form factor down to  $0.62 \times 0.32 \times 0.31$  mm<sup>3</sup>
- Pb-free package (RoHS compliant)



## 1.2 Application Examples [4]

- ESD protection in RF applications
- Tailored for connectivity applications
- WLAN, GPS antenna, DVB T/H, Bluetooth Class 1 and 2
- Automated Meter Reading

## 1.3 Product Description

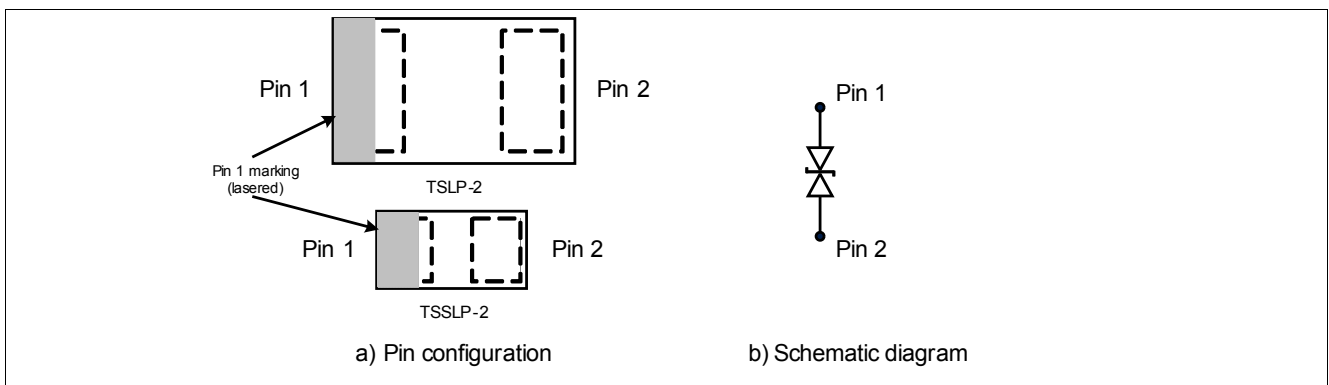


Figure 1 Pin configuration and Schematic diagram

Table 1 Ordering Information

| Type            | Package   | Configuration          | Marking code |
|-----------------|-----------|------------------------|--------------|
| ESD103-B1-02ELS | TSSLP-2-4 | 1 line, bi-directional | <u>V</u>     |
| ESD103-B1-02EL  | TSLP-2-20 | 1 line, bi-directional | V            |

## 2 Characteristics

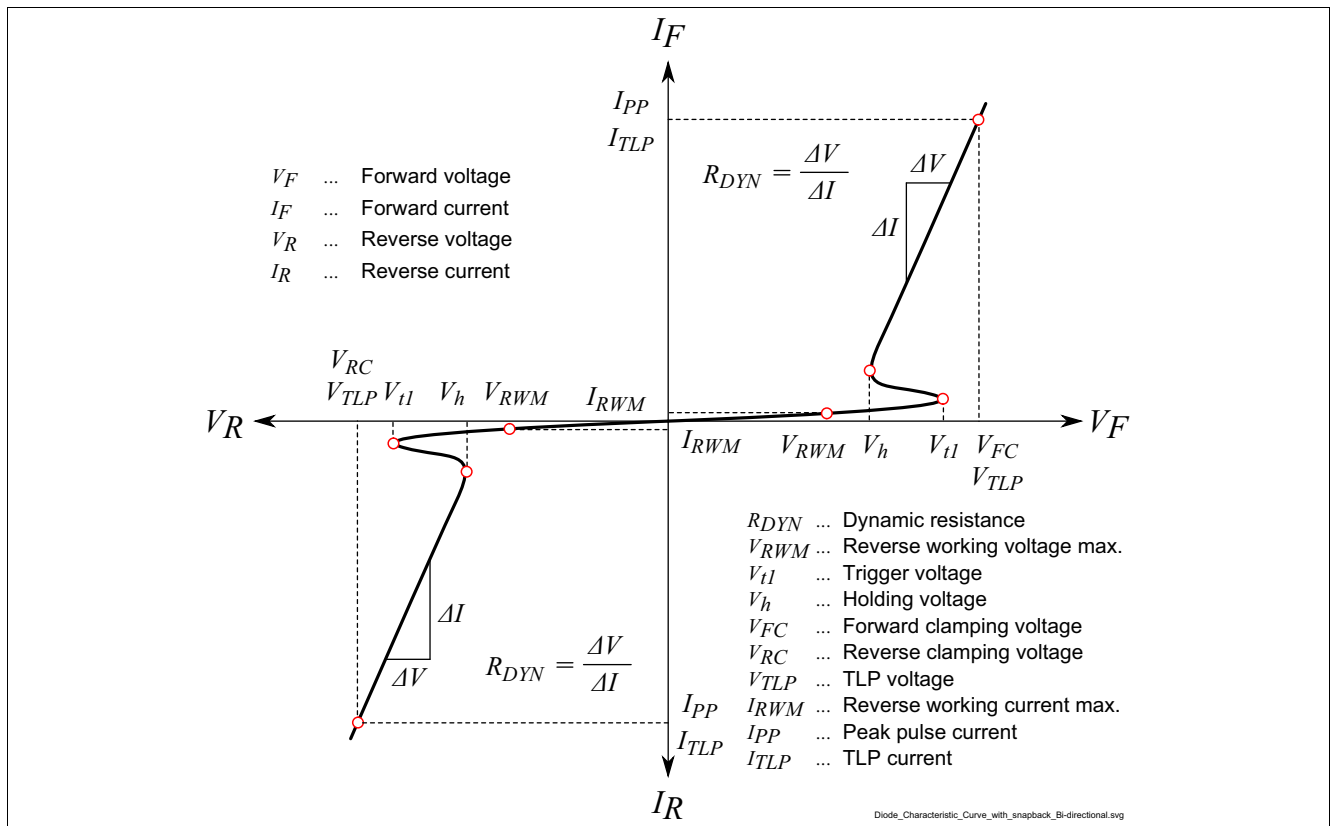
**Table 2** Maximum Ratings at  $T_A = 25\text{ °C}$ , unless otherwise specified

| Parameter                           | Symbol    | Values |      |      | Unit |
|-------------------------------------|-----------|--------|------|------|------|
|                                     |           | Min.   | Typ. | Max. |      |
| ESD contact discharge <sup>1)</sup> | $V_{ESD}$ | -10    | –    | 10   | kV   |
| Operating temperature               | $T_{OP}$  | -55    | –    | 125  | °C   |
| Storage temperature                 | $T_{stg}$ | -65    | –    | 150  | °C   |

1)  $V_{ESD}$  according to IEC61000-4-2 ( $R = 330\ \Omega$ ,  $C = 150\text{ pF}$  discharge network)

**Attention:** Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

### 2.1 Electrical Characteristics at $T_A = 25\text{ °C}$ , unless otherwise specified



**Figure 2** Definitions of electrical characteristics

**Table 3 DC Characteristics at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified**

| Parameter               | Symbol     | Values |      |      | Unit | Note / Test Condition                        |
|-------------------------|------------|--------|------|------|------|--|
|                         |            | Min.   | Typ. | Max. |      |  |
| Reverse working voltage | $V_{RWM}$  | -15    | –    | 15   | V    |  |
| Trigger voltage         | $V_{Trig}$ | –      | 21   | –    | V    | $I_{BR} = 1\text{ mA}$ , from Pin 1 to Pin 2 |
|                         |            | –      | 21   | –    |      | $I_{BR} = 1\text{ mA}$ , from Pin 2 to Pin 1 |
| Reverse current         | $I_R$      | –      | <0.1 | 50   | nA   | $V_R = 15\text{ V}$                          |

**Table 4 RF Characteristics at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified**

| Parameter         | Symbol | Values |      |      | Unit | Note / Test Condition                   |
|-------------------|--------|--------|------|------|------|---|
|                   |        | Min.   | Typ. | Max. |      |   |
| Line capacitance  | $C_L$  | –      | 0.13 | 0.2  | pF   | $V_R = 0\text{ V}$ , $f = 1\text{ MHz}$ |
|                   |        | –      | 0.09 | –    |      | $V_R = 0\text{ V}$ , $f = 1\text{ GHz}$ |
| Series inductance | $L_S$  | –      | 0.2  | –    | nH   | ESD103-B1-02ELS<br>ESD103-B1-02EL       |
|                   |        | –      | 0.4  | –    |      |   |

**Table 5 ESD Characteristics at  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified**

| Parameter                        | Symbol    | Values |      |      | Unit     | Note / Test Condition   |
|----------------------------------|-----------|--------|------|------|----------|-------------------------|
|                                  |           | Min.   | Typ. | Max. |          |                         |
| Clamping voltage <sup>1)</sup>   | $V_{CL}$  | –      | 20   | –    | V        | $I_{TLP} = 1\text{ A}$  |
|                                  |           | –      | 36   | –    |          | $I_{TLP} = 8\text{ A}$  |
|                                  |           | –      | 48   | –    |          | $I_{TLP} = 16\text{ A}$ |
| Dynamic resistance <sup>1)</sup> | $R_{DYN}$ | –      | 1.8  | –    | $\Omega$ | $t_p = 100\text{ ns}$   |

1) ANSI/ESD STM5.5.1 - Electrostatic Discharge Sensitive Testing using Transmission Line Pulse (TLP) Model. TLP conditions:  $Z_0 = 50\ \Omega$ ,  $t_p = 100\text{ ns}$ ,  $t_r = 0.6\text{ ns}$ ,  $I_{TLP}$  and  $V_{TLP}$  averaging window:  $t_1 = 30\text{ ns}$  to  $t_2 = 60\text{ ns}$ , extraction of dynamic resistance using least squares fit of TLP characteristic between  $I_{TLP1} = 2\text{ A}$  and  $I_{TLP2} = 14.1\text{ A}$ . Please refer to Application Note AN210[1].

### 3 Typical Characteristics

At  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified

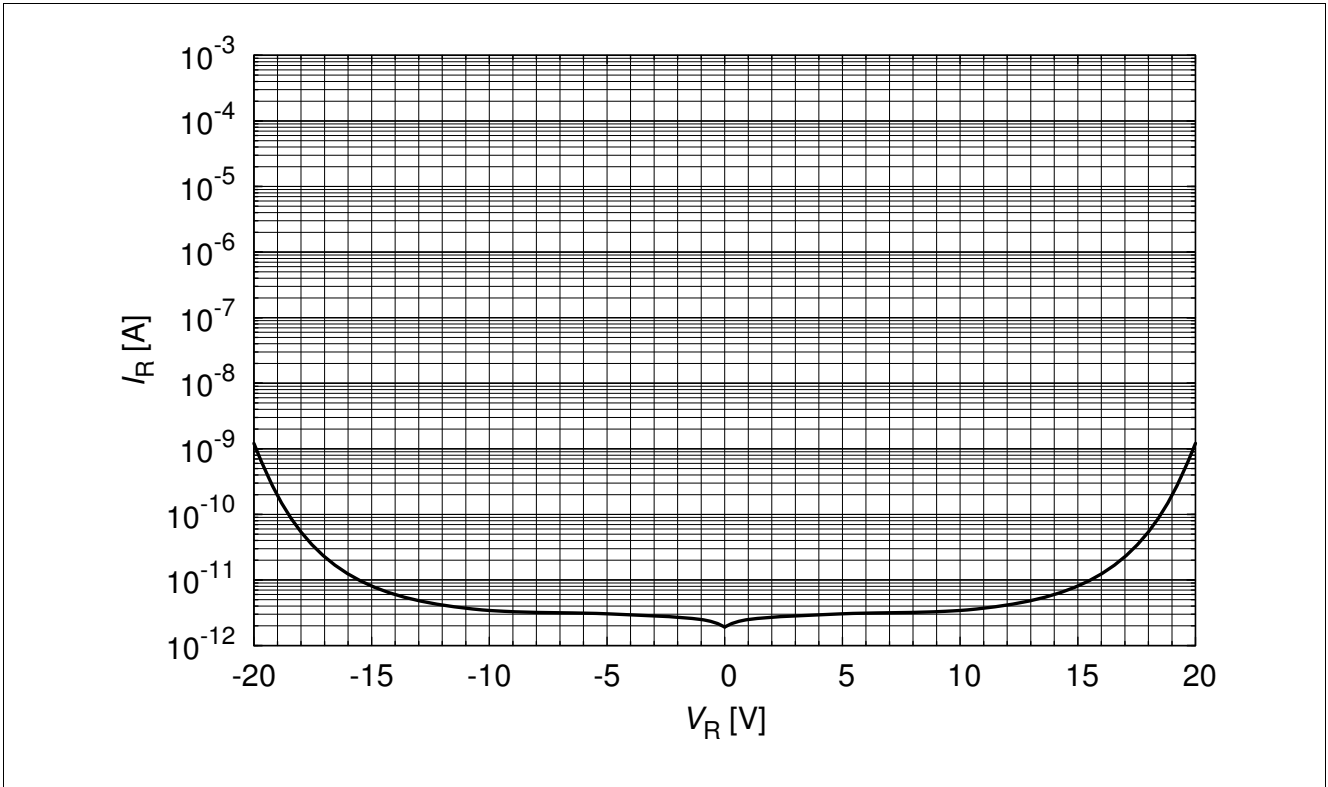


Figure 3 Reverse current  $I_R = f(V_R)$

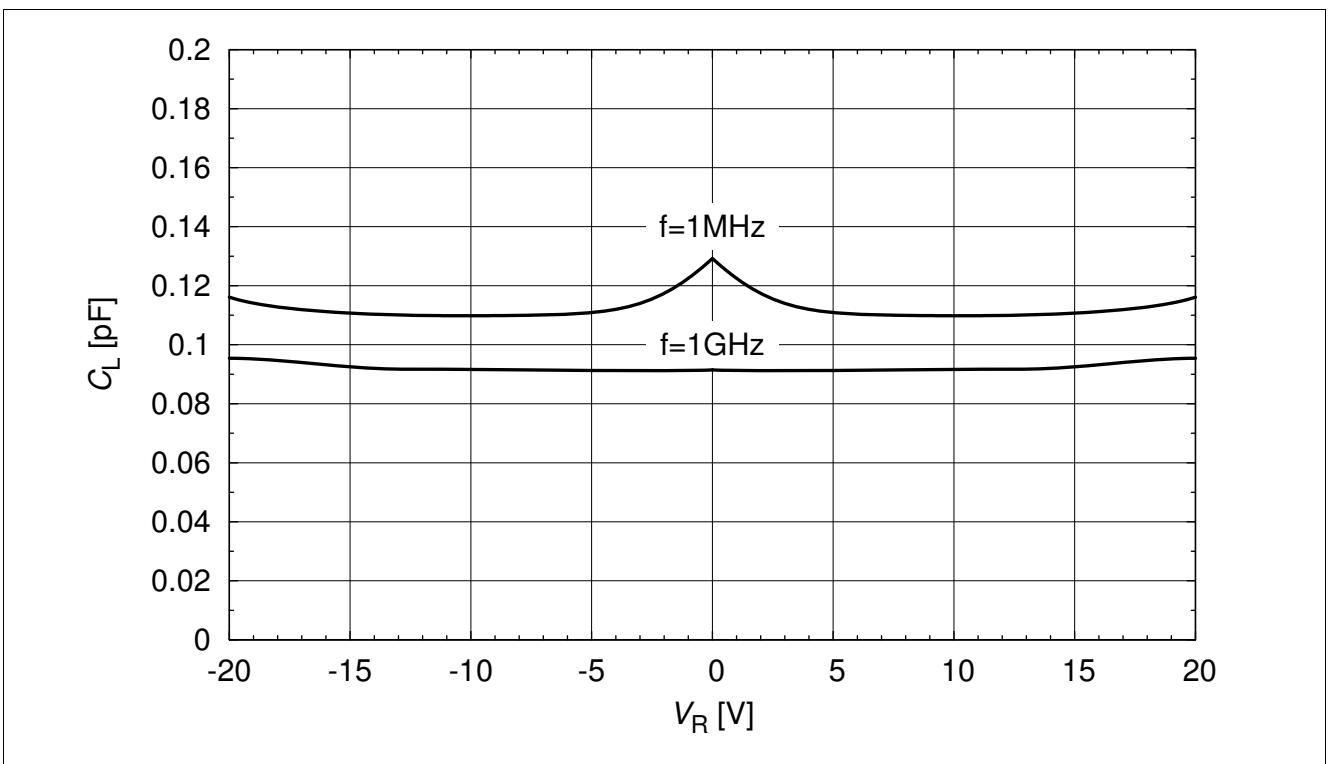


Figure 4 Line capacitance  $C_L = f(V_R), f = 1\text{ MHz}$

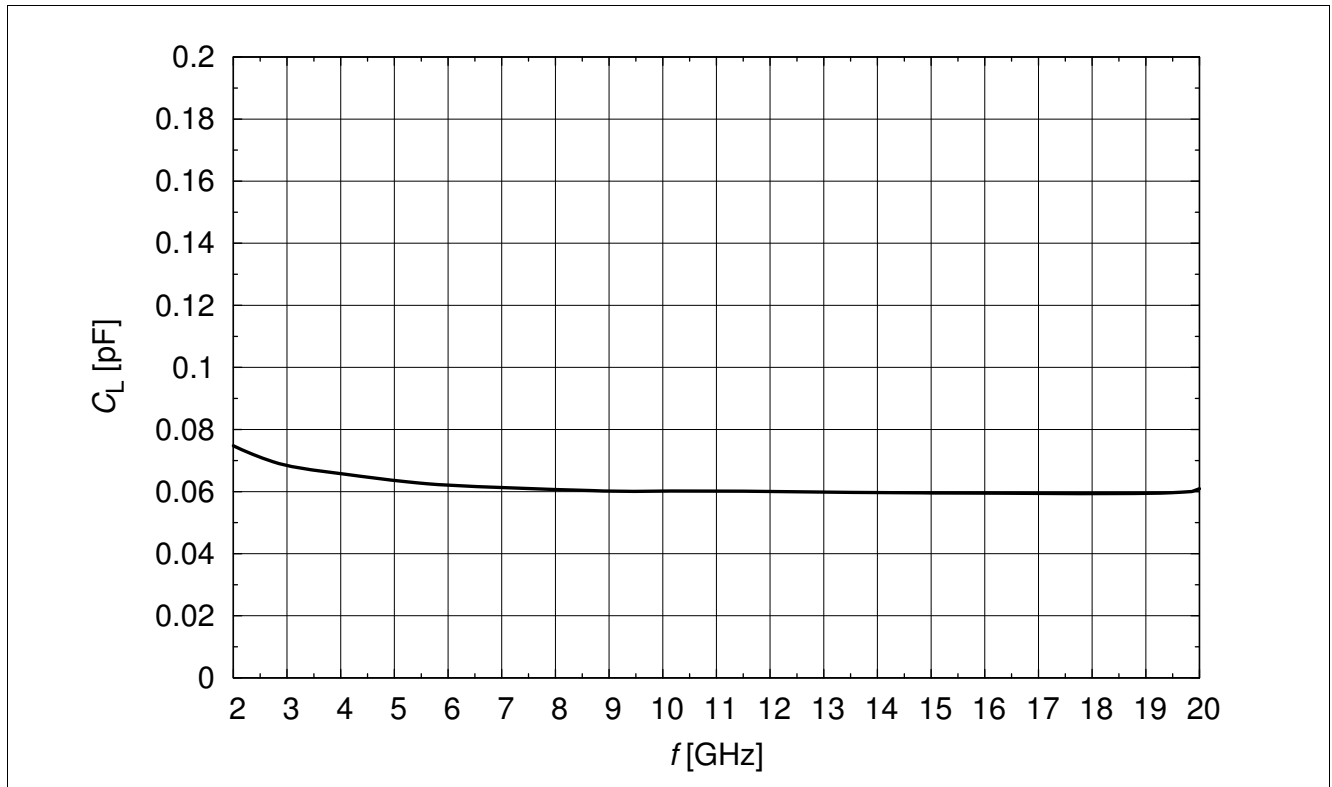
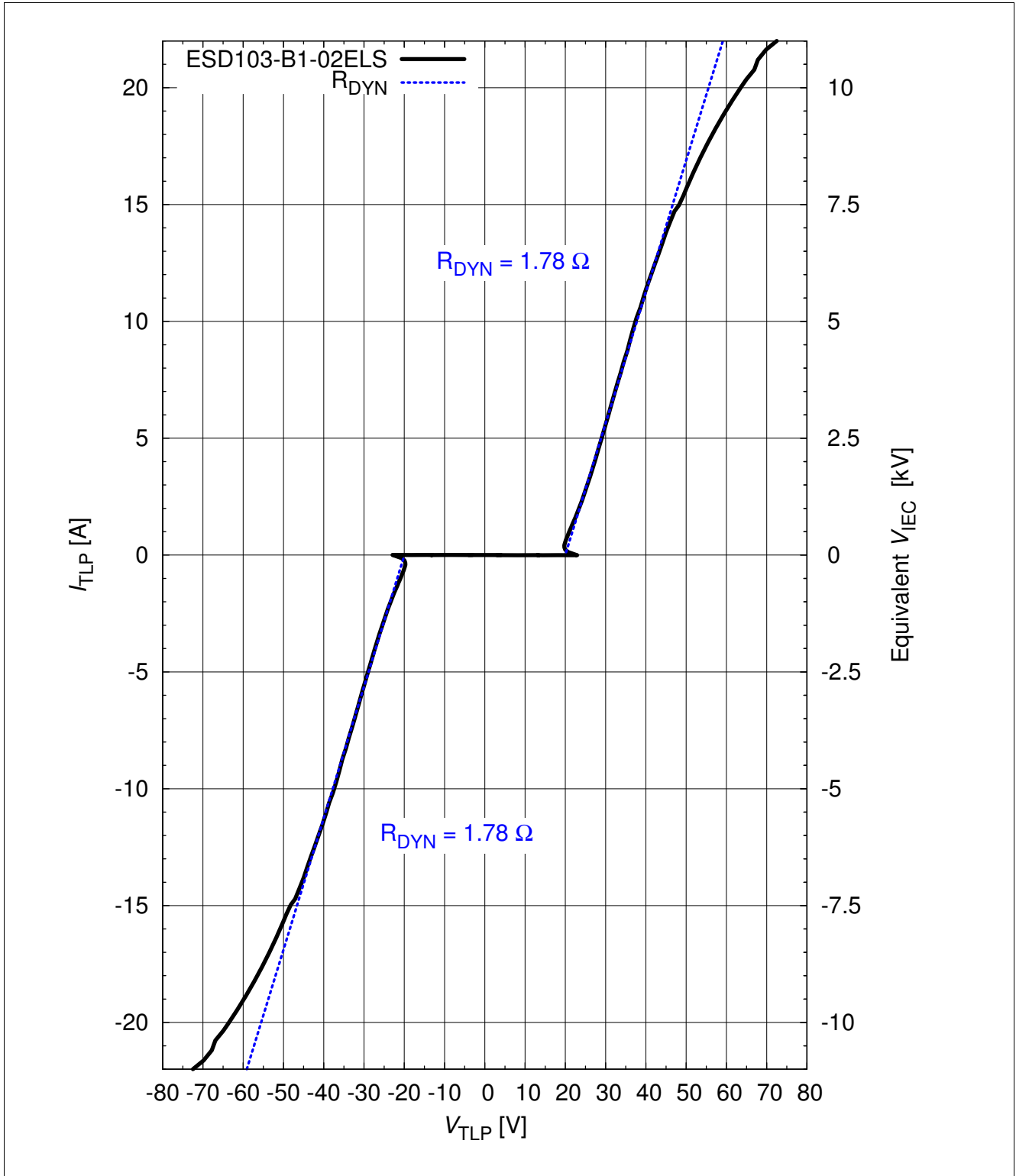


Figure 5 Line capacitance:  $C_L = f(f)$ ,  $V_R = 0$  V



**Figure 6** Clamping voltage (TLP):  $I_{TLP} = f(V_{TLP})$  according ANSI/ESDSTM5.5.1-Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model. TLP conditions:  $Z_0 = 50 \Omega$ ,  $t_p = 100 \text{ ns}$ ,  $t_r = 0.6 \text{ ns}$ ,  $I_{TLP}$  and  $V_{TLP}$  average window:  $t_1 = 30 \text{ ns}$  to  $t_2 = 60 \text{ ns}$ , extraction of dynamic resistance using squares fit to TLP characteristics between  $I_{TLP1} = 2 \text{ A}$  and  $I_{TLP2} = 14.1 \text{ A}$ . Please refer to Application Note AN210[1]



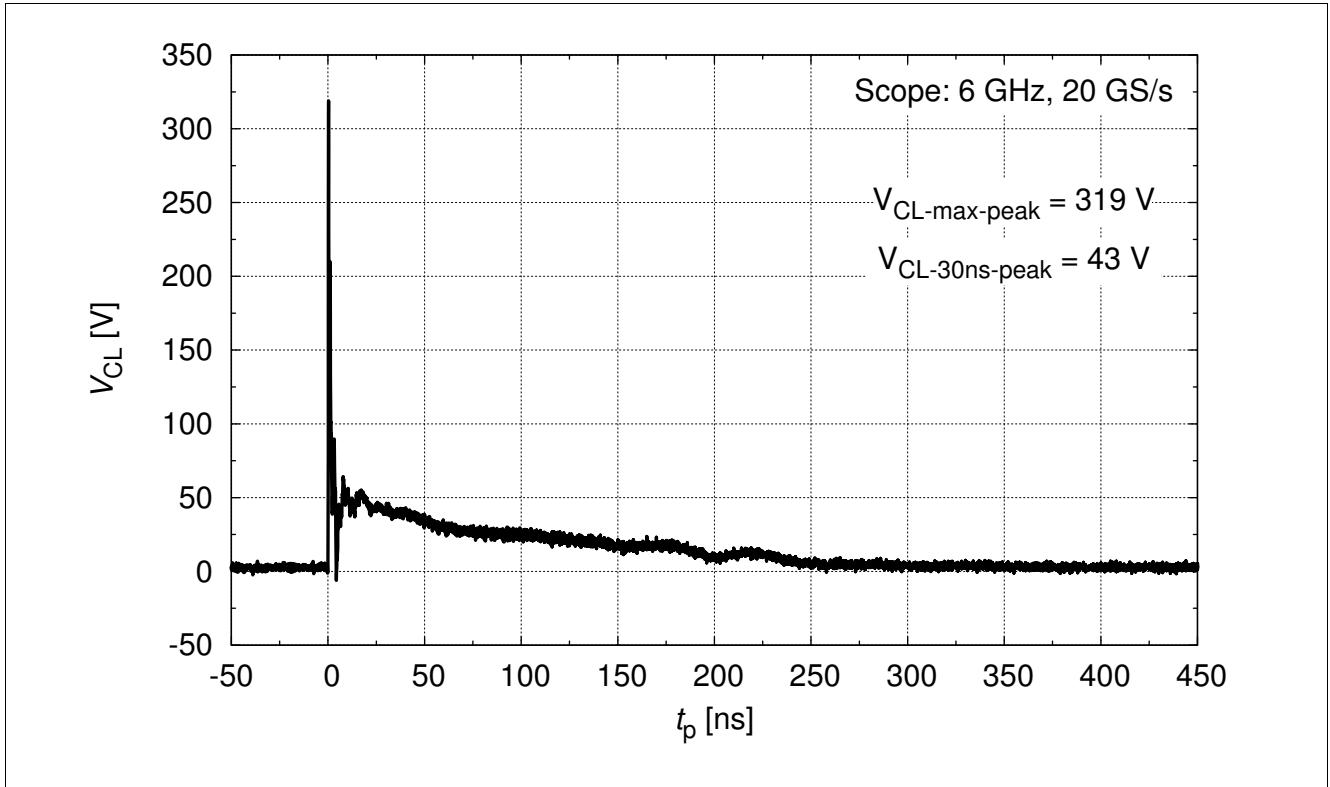


Figure 7 Clamping voltage at +8 kV discharge according IEC61000-4-2 ( $R = 330 \Omega$ ,  $C = 150 \text{ pF}$ )

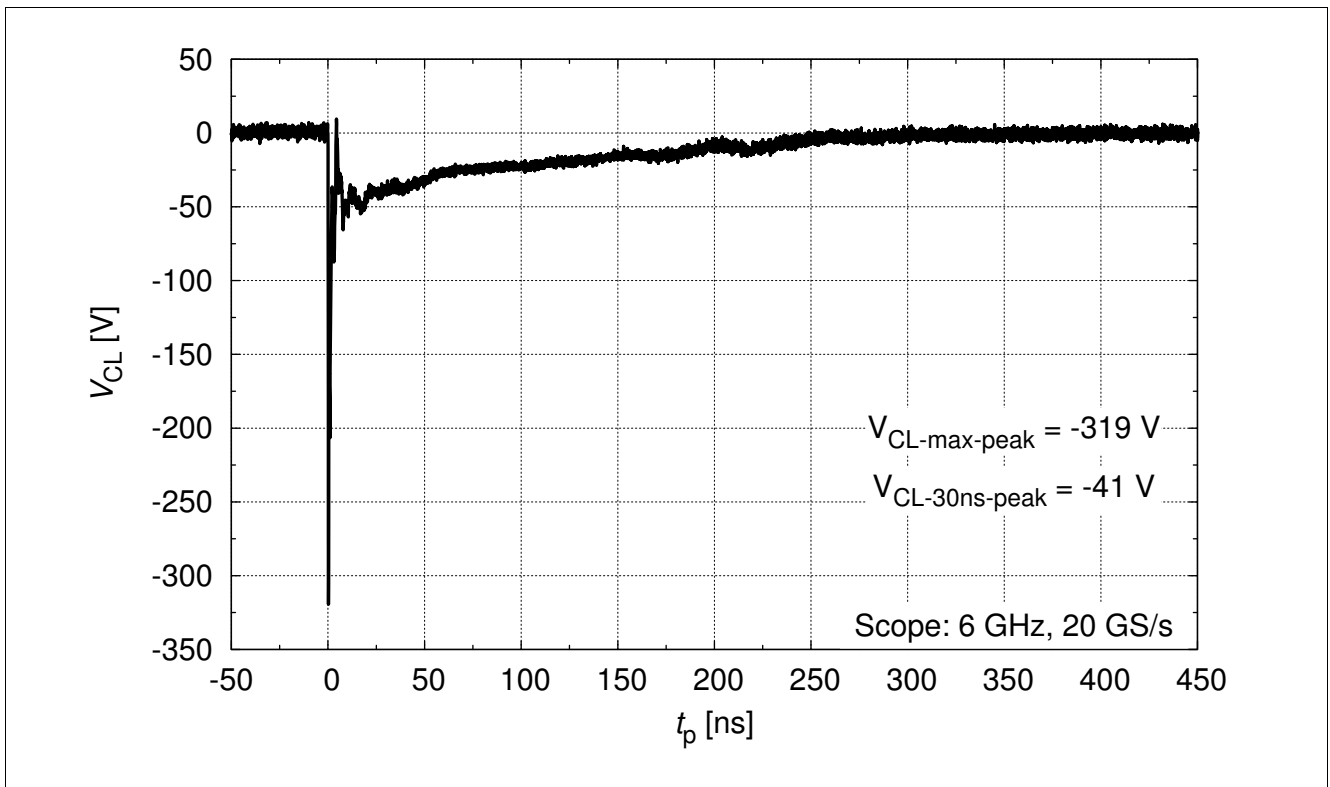


Figure 8 Clamping voltage at -8 kV discharge according IEC61000-4-2 ( $R = 330 \Omega$ ,  $C = 150 \text{ pF}$ )

## 4 Package Information

### 4.1 TSSLP-2-4 [2]

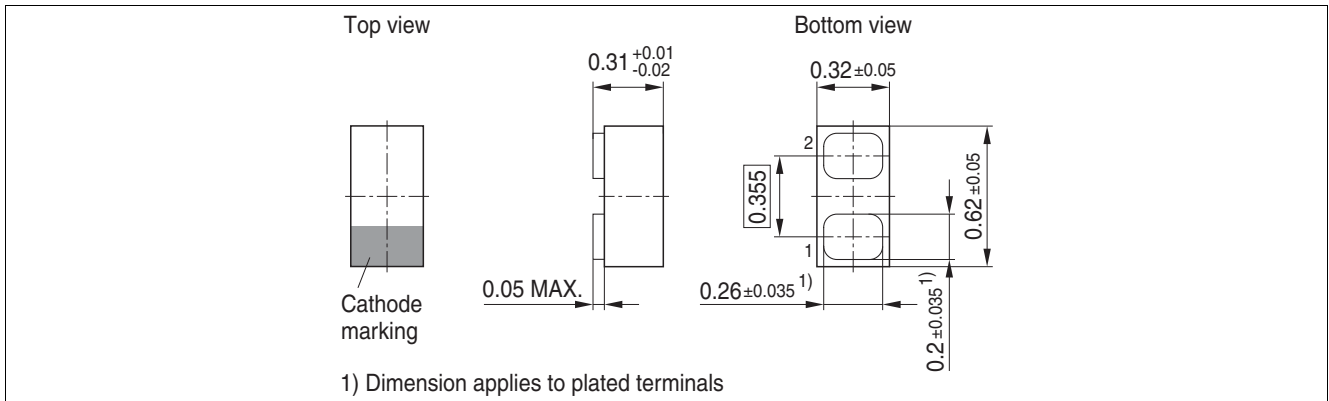


Figure 9 TSSLP-2-4 Package outline

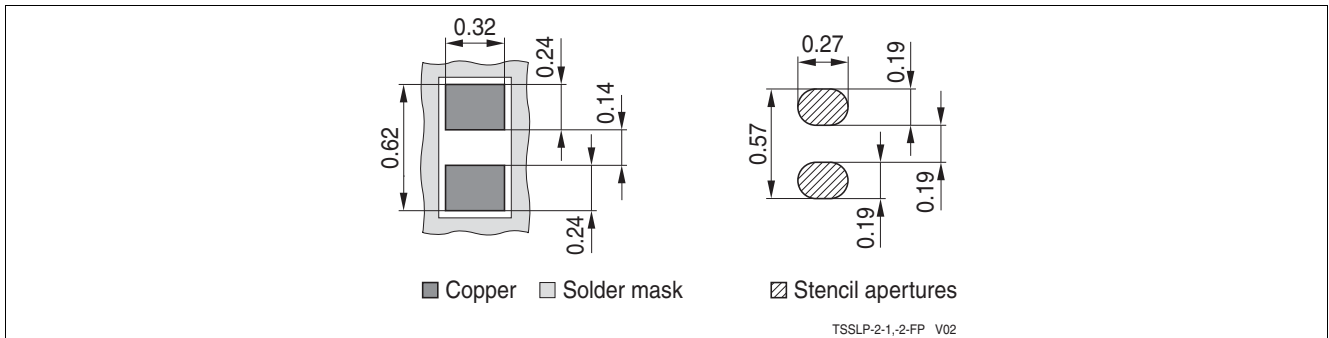


Figure 10 TSSLP-2-4 Footprint

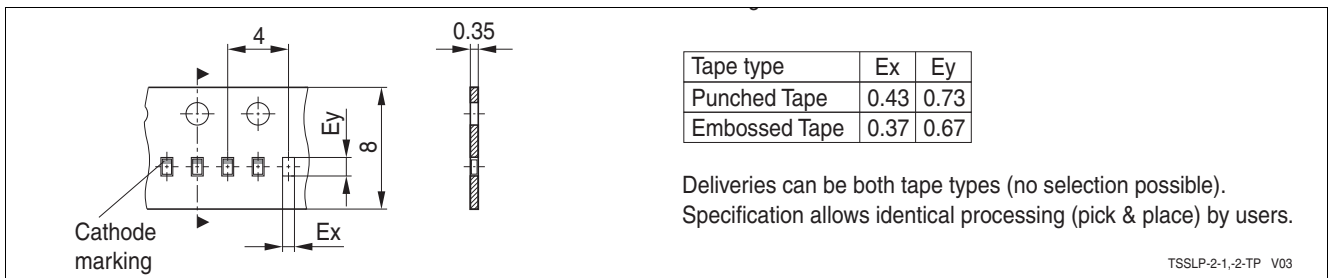


Figure 11 TSSLP-2-4 Packing

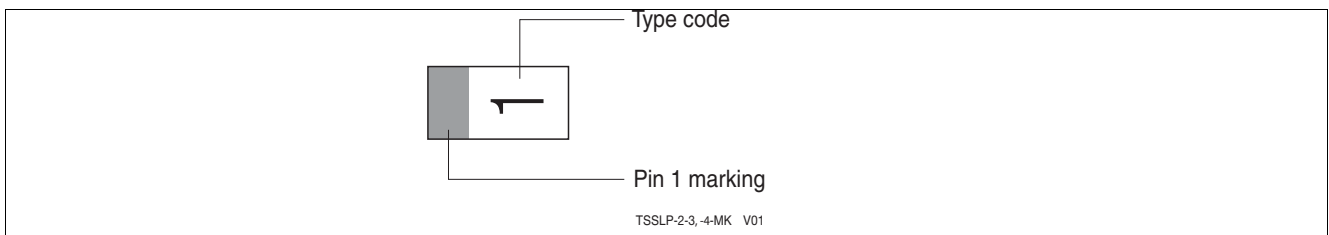


Figure 12 TSSLP-2-4 Marking (example)

4.2 TSLP-2-20 [2]

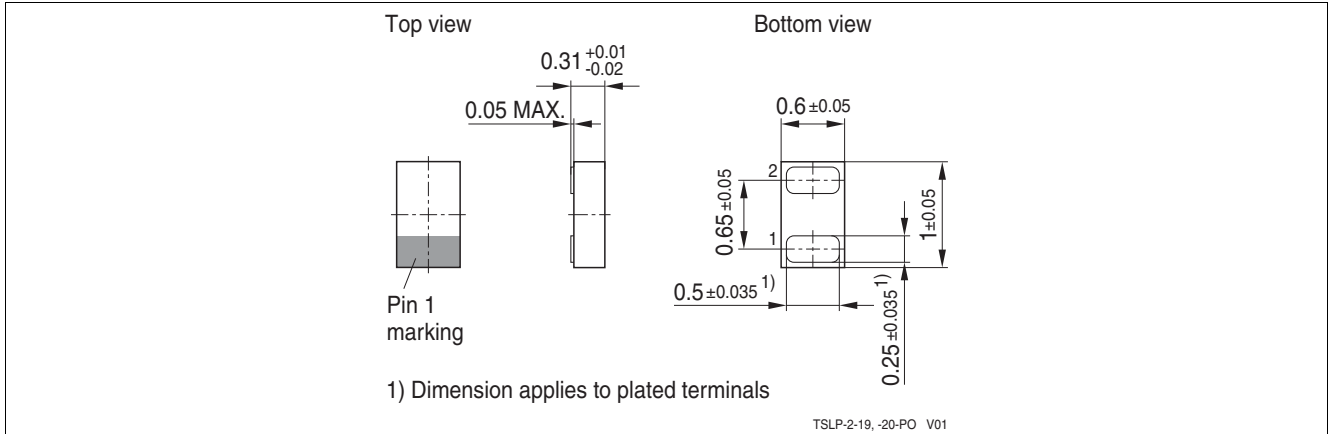


Figure 13 TSLP-2-20 Package outline

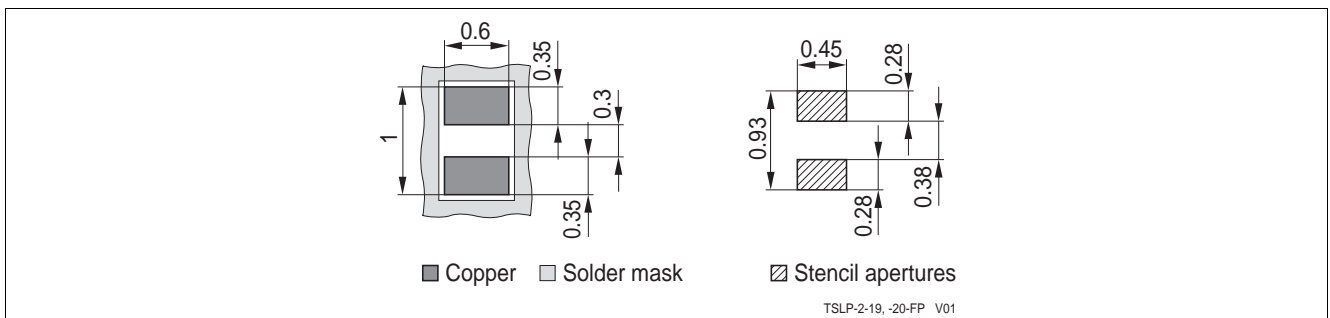


Figure 14 TSLP-2-20 Footprint

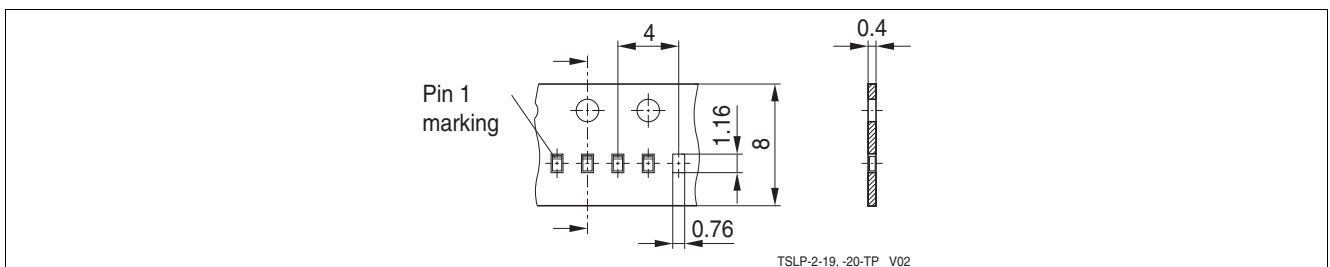


Figure 15 TSLP-2-20 Packing

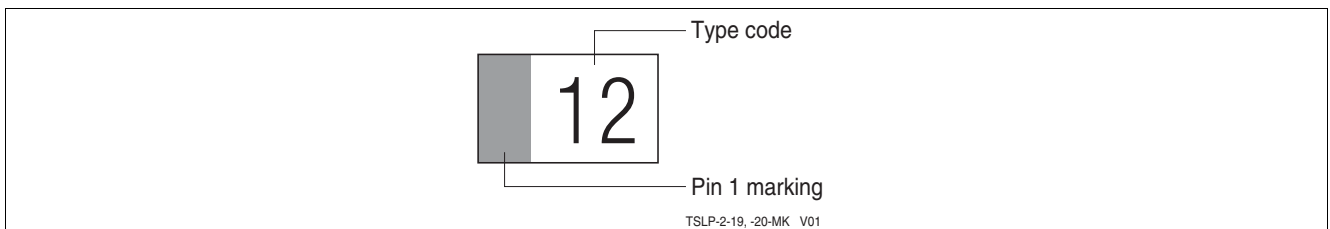


Figure 16 TSLP-2-20 Marking (example)

## References

- [1] Infineon AG - **Application Note AN210**: Effective ESD Protection Design at System Level using VF-TLP Characterization Methodology
- [2] Infineon AG - Recommendations for PCB Assembly of Infineon TSLP and TSSLP Packages
- [3] Tero, Ranta, Juha Ellä, Helena Pohjonen: Antenna Switch Linearity Requirements for GSM/WCDMA Mobile Phone Front-Ends. Nokia Technology Platforms, P.O.Box 86, FIN-24101 SALO.
- [4] Infineon AC - Application Note AN327: ESD101-B1 / ESD103-B1, Bi-directional Ultra Low Capacitance Transient Voltage Suppression Diodes for High Power RF Applications.

**Revision History: Revision 1.2, 2013-07-22**

| Page or Item                    | Subjects (major changes since previous revision) |
|---------------------------------|--|
| <b>Revision 1.3, 2014-06-12</b> |  |
| 6                               | Table 5) updated                                 |
|                                 |  |
|                                 |  |
|                                 |  |
|                                 |  |

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